

CLAIMS:

1. A method for imaging anisotropic media comprising:

selecting multiple points within the anisotropic media, which is to be imaged;
determining an acoustic path between each selected point in the anisotropic media and a receiver position on the surface of the anisotropic media;

calculating an acoustic wave velocity at all necessary points; determining an acoustic path length based on each selected point in the anisotropic media and the receiver position;

determining a time delay for each acoustic wave between each image point and the receiver position on the surface of the anisotropic media;

calculating a sum for each point selected based on the appropriate acoustic wave velocities and the acoustic path lengths ; and

generating an image of the anisotropic media using the coherent sums generated for each said image point selected.
2. The method of Claim 1, wherein the determining the acoustic path between each selected point in the anisotropic media and a receiver position on the surface of the anisotropic media comprises postulating a direct path for the wave.
3. The method of Claim 1, wherein the determining the acoustic path between each selected point in the anisotropic media and a receiver position further comprises adjusting the wave normal to the postulated path using a least squares minimization routine such that the wave normal is adjusted to a point where the ray trajectory intersects the sensing surface at a point where the receiver location is desired.
4. The method of Claim 1, wherein the calculating the acoustic wave velocity in any direction is accomplished by solving a Christoffel equation.

5. The method of Claim 1, wherein the calculating the acoustic wave velocity further comprises determining phase and group velocities, and further wherein the phase and group velocities are determined by a knowledge of fundamental material properties of the anisotropic media.

6. The method of Claim 5, wherein the phase and group velocities in the anisotropic media are determined from engine drawings used to design and manufacture parts.

7. The method of Claim 1, wherein the calculating the acoustic wave velocity is accomplished by further determining the beam skew.

8. The method of Claim 1, wherein the beam skew may be determined by a localized form of Snell's law, a variational calculus formulation based on Fermat's principle, or a full field finite difference model that tracks the wavefronts associated with each mode of propagation.

9. The method of Claim 1, wherein the calculating a sum involves calculating a coherent sum.

10. The method of Claim 1, wherein the calculating a sum involves calculating an incoherent sum.

11. The method of Claim 1, wherein the calculating a sum involves calculating a partially coherent sum.

12. A method for imaging anisotropic media comprising:
slicing the anisotropic media;
irradiating the anisotropic media with a point acoustic source;
scanning the anisotropic media with a receiver to map out a sound field;
determining a time delay in an acoustic wave from the sound field; and
incorporating the time delay into an algorithm to provide enhanced resolution and sensitivity for the image.

13. The method Claim 12, wherein the algorithm is represented by the equations (1):

$$I(x_i, y_i, z_i) = \sum_j U(x_j, y_j, z_j, \Delta t_{ij}) \quad (1)$$

where Δt_{ij} is the round trip time delay for sound propagation from the observation point (x_i, y_i, z_i) to the image point (x_j, y_j, z_j) , and by equation (2)

$$\Delta t_{ij} = \left[(x_i - x_j)^2 + (y_i - y_j)^2 + (z_i - z_j)^2 \right]^{1/2} / V_{material} \quad (2)$$

where $V_{material}$ is the speed of the acoustic wave in the isotropic material.

14. The method Claim 12, wherein the acoustic point source is a laser, a conventional array transducer, or a phased array transducer.